

Identification of hairs of some Indian Mammals¹

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(With 21 text-figures)

A system for rapidly identifying hair specimens by means of structural patterns is outlined. A series of camera lucida diagrams depicting the structure of hairs from 21 species of mammals is presented. This facilitates identification by permitting a direct visual comparison with the structure of an unknown hair specimen. Comments on distinguishing features that may be useful for macroscopic recognition of hairs from the various species are also included.

INTRODUCTION

The Project Tiger in Maharashtra was initiated in the Melghat Tiger Reserve on 22nd February, 1974 with the main object of protecting and conserving the tiger. One important aspect of study which relates to the tiger is to know its food habits. In nature it is very difficult to keep track of all the animals killed by the tiger and an important method of knowing the food habits is through collection of faeces containing hair which will reveal the animals preyed upon by the tiger. The need for studying food habits of Carnivora in general and of the tiger in particular prompted us to undertake a study of mammalian hair structure that could be used for investigating food habits on the basis of hair remains in the faeces.

The present work involves the study of the actual hair. The animals investigated so far do not cover a complete list of mammals of Maharashtra or of the Project Tiger area. However, the study will be continued on other species of mammals depending on the availability of authentic hair specimens.

The practical applications of hair identification in biological and forensic sciences have been enumerated by several investigators (Mathiak 1938; Williams 1938; Mayer 1952; Adorjan & Kolenosky 1969). Some of the uses cited most frequently involve food habit studies, identity of a predator in cases of predation and the identity of a mammal inhabiting a den or a tree. Hair remains also serve as evidence in convicting a game law violator or determination of the authenticity of a fur coat.

The history of hair identification can be traced back to McMurtrie (1886) who studied different patterns of the cuticular surface of animal hair. Hausman (1920, 1924 & 1930) made drawings of different mammalian hairs which were of great taxonomic importance. The purpose of this investigation is to provide a set of illustrations of the structural pattern of mammalian hairs that can be used to make rapid visual comparison with unknown hair samples. This will eliminate the necessity of preparing and examining several known hair specimens each time an identification is to be made. A brief written description of the major

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macroscopic and microscopic distinguishing characteristics of the hairs of each species is given along with drawings.

MATERIAL AND METHODS

Initially, all hair specimens were carefully washed in hot water. They were air dried thoroughly and passed through ether and xylol. Hair slides were prepared in Canada-balsam. Camera lucida drawings were prepared of each hair showing cuticular and medullar pattern. The three basic regions of each hair fibre namely proximal, medial and distal were studied. The diagrams on the left hand side in the plates show the structure of hairs of the proximal end, in the middle the medial and on the right the distal end. In cases where the structure of proximal and medial portions of hair was identical, only one diagram was drawn representing both. The measurements given are averages.

OBSERVATIONS

The structural parts of a hair are the cuticle, cortex, medulla, pigment and hair cells. In the system of hair identification to be outlined only cuticle and medulla are important.

INDIAN PANGOLIN *Manis pentadactyla*

Fig. 1

Gross Appearance:

Length 2.4 cm. Colour milky white. Hair stems harsh and rigid with a diameter of 126 μ at the proximal end. Stems slightly curved.

Microscopic Appearance:

Hair border plain with small spines distributed all over. Medulla is visible only at the proximal region but not in the medial and distal regions.

RHESUS MACAQUE *Macaca mulatta*

Fig. 2

Gross Appearance:

Length 1.6 cm. Colour dusky gray. The hair measures 38 μ in diameter at the proximal end. Proximal and distal regions have fragmented medulla while the medial region has discoidal type.

Microscopic Appearance:

The hairs appear without scales. The hair pigment punctated or threadlike and is seen in the medial and distal regions of the hair; the proximal region lacks pigment.

LANGUR *Presbytis entellus*

Fig. 3

Gross Appearance:

Length 6.2 cm. Colour uniform gray. The hair measures 60 μ in diameter in the proximal region.

Microscopic Appearance:

In the proximal and medial regions, the border of the hair shows scales which are imbricate and at the distal region the borders appear plain. The hair pigment which is punctated and threadlike is seen uniformly in all regions of the hair. Medulla is not visible in any region.

BLACKNAPED HARE *Lepus ruficaudatus*

Fig. 4

Gross Appearance:

Length 3.5 to 4.8 cm. The hairs are slender and soft, with diameter of 12 μ throughout except for the slight tapering apex. They are light brown in colour with black tips.

Microscopic Appearance:

In the proximal region the medulla appears beaded, in the medial discoidal and in the distal region fragmented. Scales are not visible.

IDENTIFICATION OF HAIRS

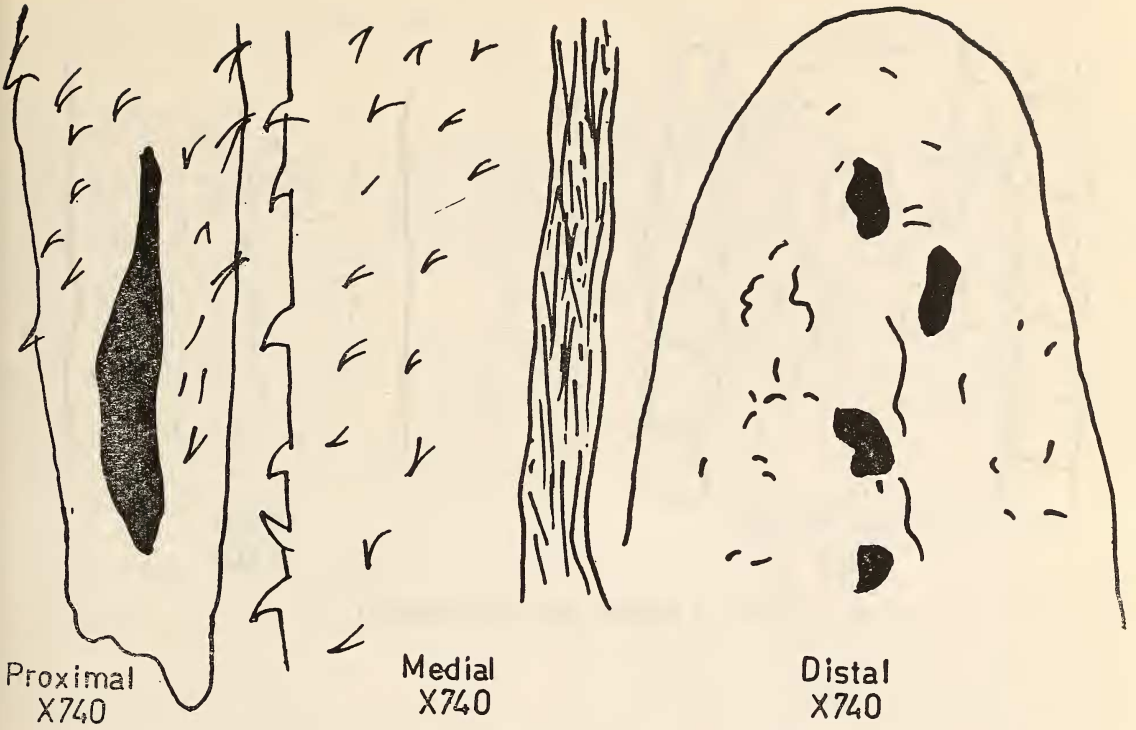


Fig. 1. Pangolin (*Manis pentadactyla*)

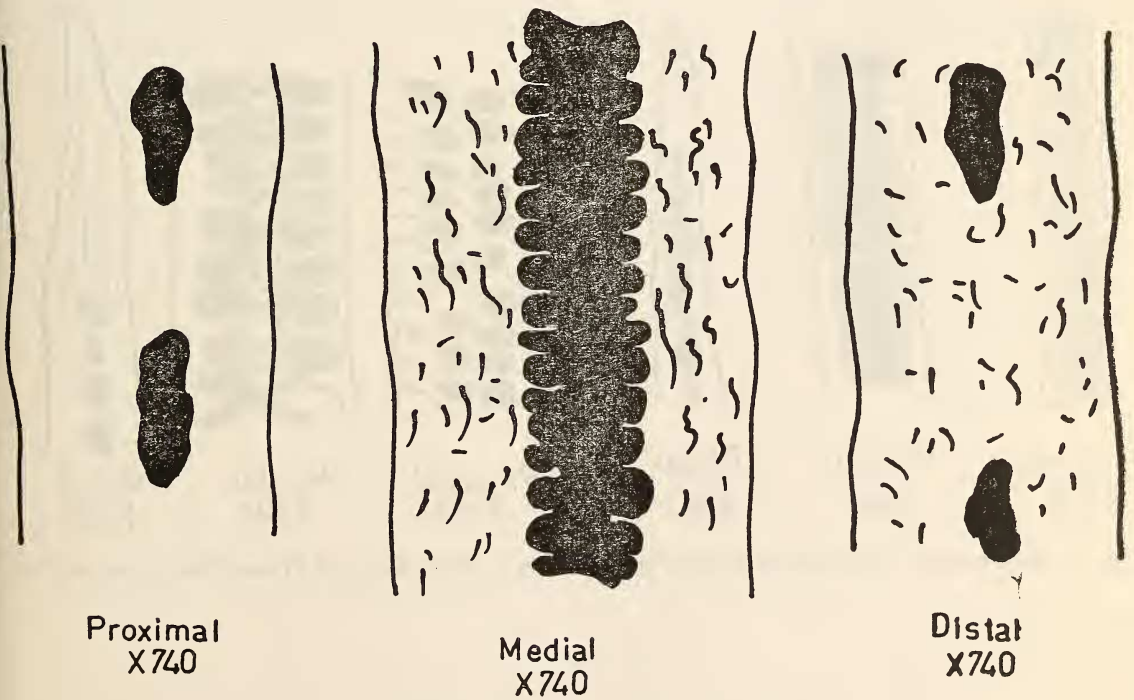


Fig. 2. Rhesus Macaque (*Macaca mulatta*)

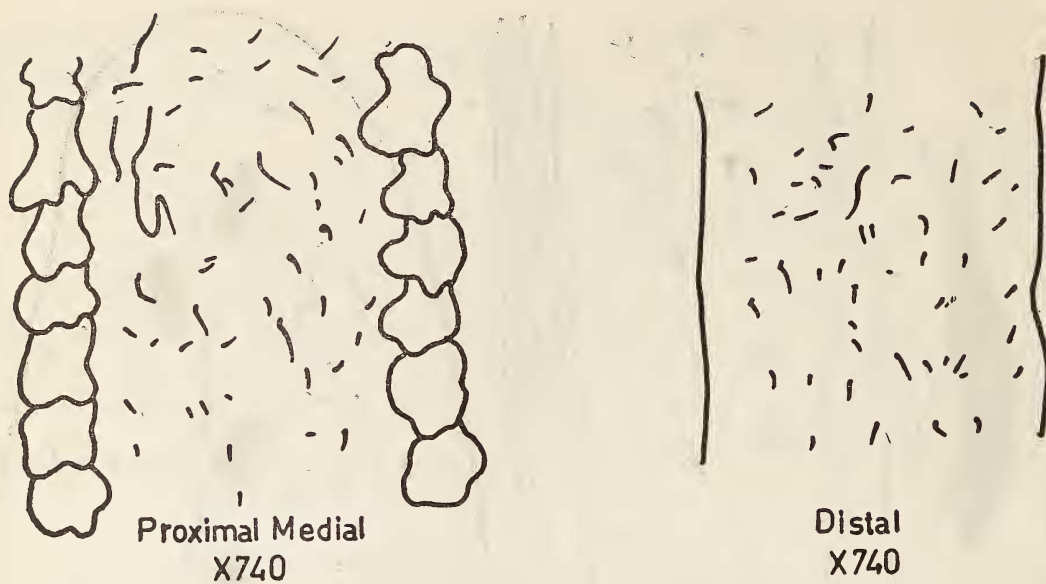


Fig. 3. Langur (*Presbytis entellus*)

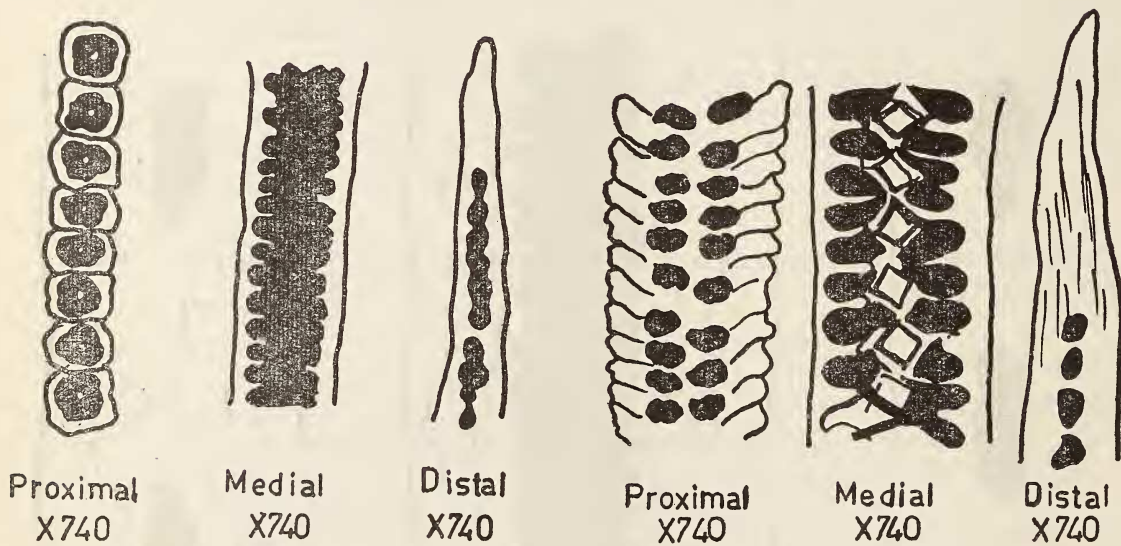


Fig. 4. Blacknaped Hare (*Lepus ruficaudatus*)

Fig. 5. Palm Squirrel (*Funambulus palmarum*)

IDENTIFICATION OF HAIRS

PALM SQUIRREL *Funambulus palmarum*

Fig. 5

Gross Appearance:

Length 1.4 to 2 cm. The hairs differ in colour. Some are black and some are banded in appearance with white and brown bands arranged alternatively. They measure 27 μ in diameter in the proximal region.

Microscopic Appearance:

Scales are imbricate with plain edges in the proximal region. In the medial and distal regions the borders appear plain. In the proximal region medulla is of fragmented type arranged in double rows. In the medial region it appears discoidal, which however in the core portion shows a chiasmatic appearance. In the distal region the medulla is of fragmented type.

LESSER BANDICOOT RAT *Bandicota bengalensis*

Fig. 6

Gross Appearance:

Length 2 to 3 cm. The colour of the hair is generally gray except in the distal region which is black. The hair measures 45 μ in diameter in the proximal region.

Microscopic Appearance:

Scales are dentate in the proximal region. In the medial region the borders appear plain while in the distal region the scales are imbricate acuminate.

Medulla in the proximal region appears discoidal while it is continuous in the medial and distal regions.

STRIPED HYENA *Hyaena hyaena*

Fig. 7

Gross Appearance:

The proximal region is white, medial gray and distal black.

Length 16.8 cm. The hairs are straight wire-like with a gradual taper. The diameter of the hair at the proximal region measures 60 μ .

Microscopic Appearance:

No scales are visible and the borders are plain. Medulla in the proximal and medial regions is continuous while in the distal region it is fragmented.

JACKAL *Canis aureus*

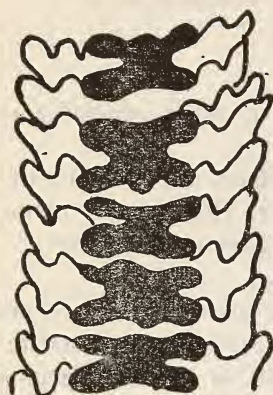
Fig. 8

Gross Appearance:

Length 4 to 6 cm. Hair stems are narrow at the proximal region becoming a little broader in the medial and tapering in the distal region. At the broadest portion the hair diameter measures 90 μ . The hairs show a banded coloration due to the presence of brown or black bands which are separated from each other by yellow bands.

Microscopic Appearance:

Scales imbricate acuminate in proximal region, changing to crenate in the medial, and flattened in the distal region giving a smooth appearance to the borders. Medulla is continuous in the proximal region, discoidal giving a horizontal triangular appearance in the medial region and fragmented in the distal region.



Proximal
X 740

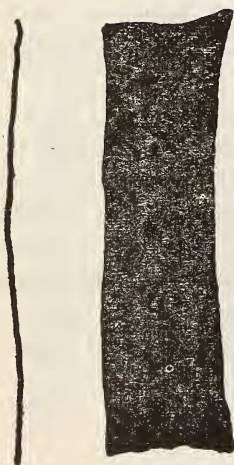


Medial
X740



Distal
X740

Fig. 6. Lesser Bandicoot Rat (*Bandicota bengalensis*)



Proximal
X 740



medial
X740



Distal
X740

Fig. 7. Striped Hyena (*Hyaena hyaena*)

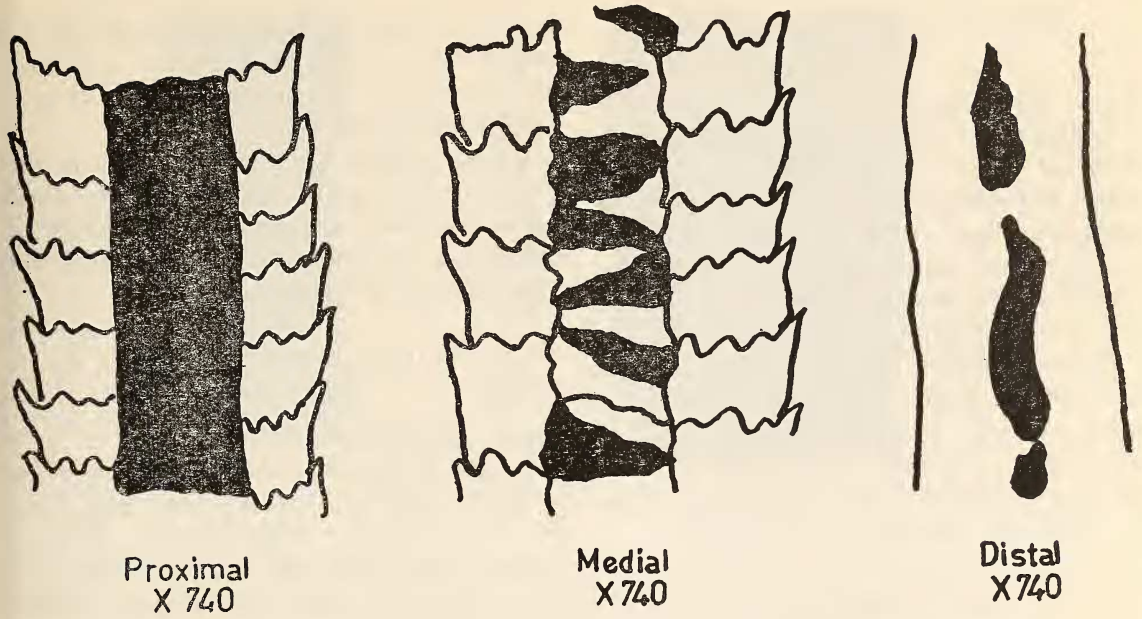


Fig. 8. Jackal (*Canis aureus*)

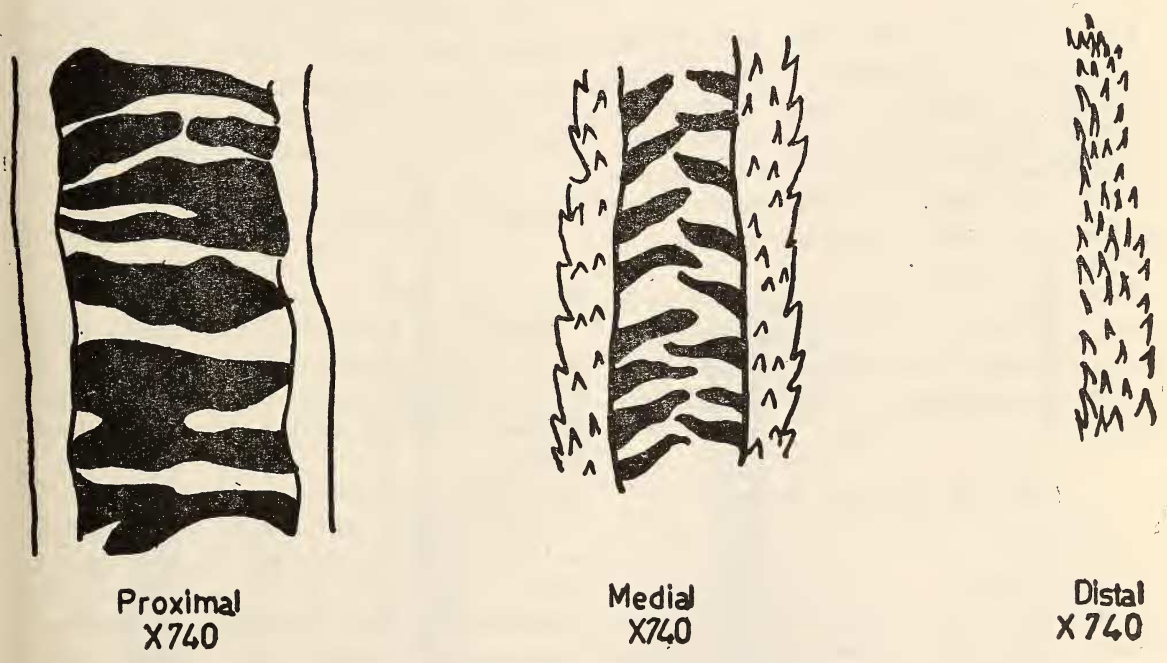


Fig. 9. Indian Fox (*Vulpes bengalensis*)

INDIAN FOX *Vulpes bengalensis*

Fig. 9

Gross Appearance:

Length 4 to 5 cm. They measure 60μ in the proximal region. Colour black in the distal region and yellow in the proximal region. Some hairs are black except for lighter coloured bands, several centimetres wide in the upper portion of the medial region.

Microscopic Appearance:

Proximal region appears smooth, medial spiny dentate while in the distal region minute spines are seen. Medulla in the proximal region appears discoidal, in the medial intervening fragmented type and in the distal region no medulla is visible.

TIGER *Panthera tigris*

Fig. 10

Gross Appearance:

Length 4 to 8 cm. Hair stems thick, slightly curved at the tip. Diameter at the proximal region 84μ . Colour of the hair is white in the proximal region, and dark gray in the distal. In the medial region yellow bands are separated from each other by brown bands. Some hairs are pure white and black in colour.

Microscopic Appearance:

In the proximal region the scales appear as spines on the borders, while in the medial and distal regions the borders appear plain. Medulla is continuous throughout except in the distal region where it is not visible.

PANTHER *Panthera pardus*

Fig. 11

Gross Appearance:

Length 3 to 4 cm. Hair stems are soft and slender. Colour light yellow in the proximal region, followed by two bands approximate-

ly 5 mm. wide, the first being black and the second brown. The distal portion is yellow. The diameter at the proximal region, 45μ .

Microscopic Appearance:

Scales imbricate with crenate edges in the proximal and medial regions. In the distal region the borders appear plain. Medulla is continuous throughout except in the distal region where it is fragmented.

JUNGLE CAT *Felis chaus*

Fig. 12

Gross Appearance:

Length 2 to 4 cm. Coloration of hair stems is highly specific. They are light gray from proximal to medial region which is followed by two bands black and brown in the distal region. The tip is black. The diameter at proximal region is 30μ

Microscopic Appearance:

Scales imbricate with dentate edges in the proximal and medial regions. In the distal region the scales appear to be coronal. Medulla is discoidal in the proximal and medial regions while in the distal region it is continuous.

PALM CIVET *Paradoxurus hermaphroditus*

Fig. 13

Gross Appearance:

Length 2 to 4 cm. Hair stems slightly wavy and soft. The diameter at proximal region is 66μ . Colour dusty gray in proximal region, gradually becoming darker towards the distal region.

Microscopic Appearance:

Scales imbricate with crenate edges in proximal region, which gradually become coronal in the medial region. In the distal region the borders appear plain. Medulla in the proximal region appears discoidal, in the medial continuous and in the distal fragmented.

IDENTIFICATION OF HAIRS

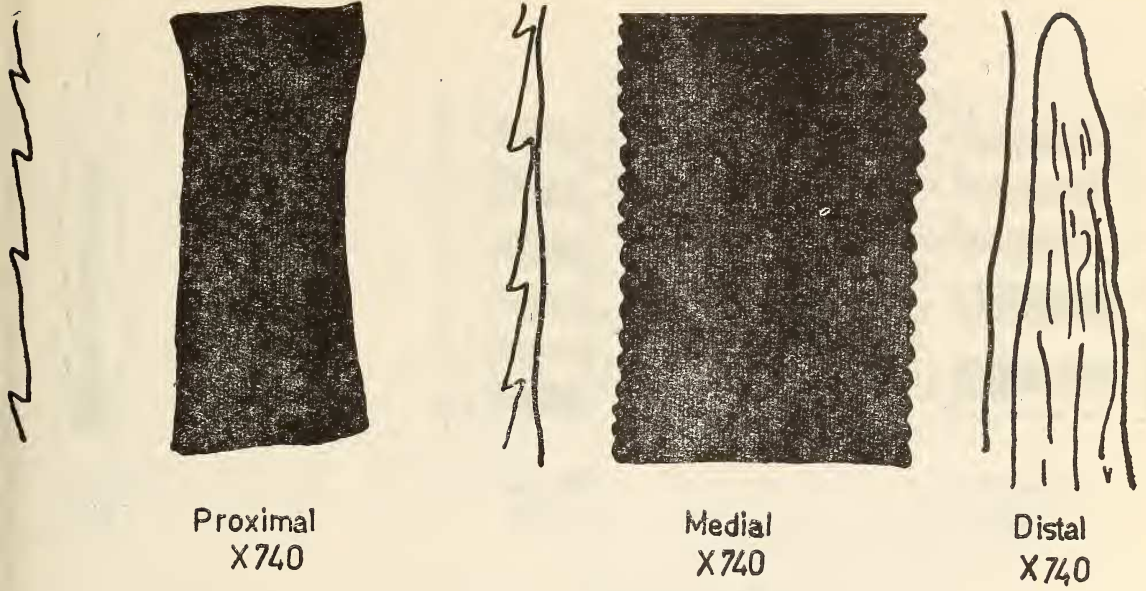


Fig. 10. Tiger (*Panthera tigris*)

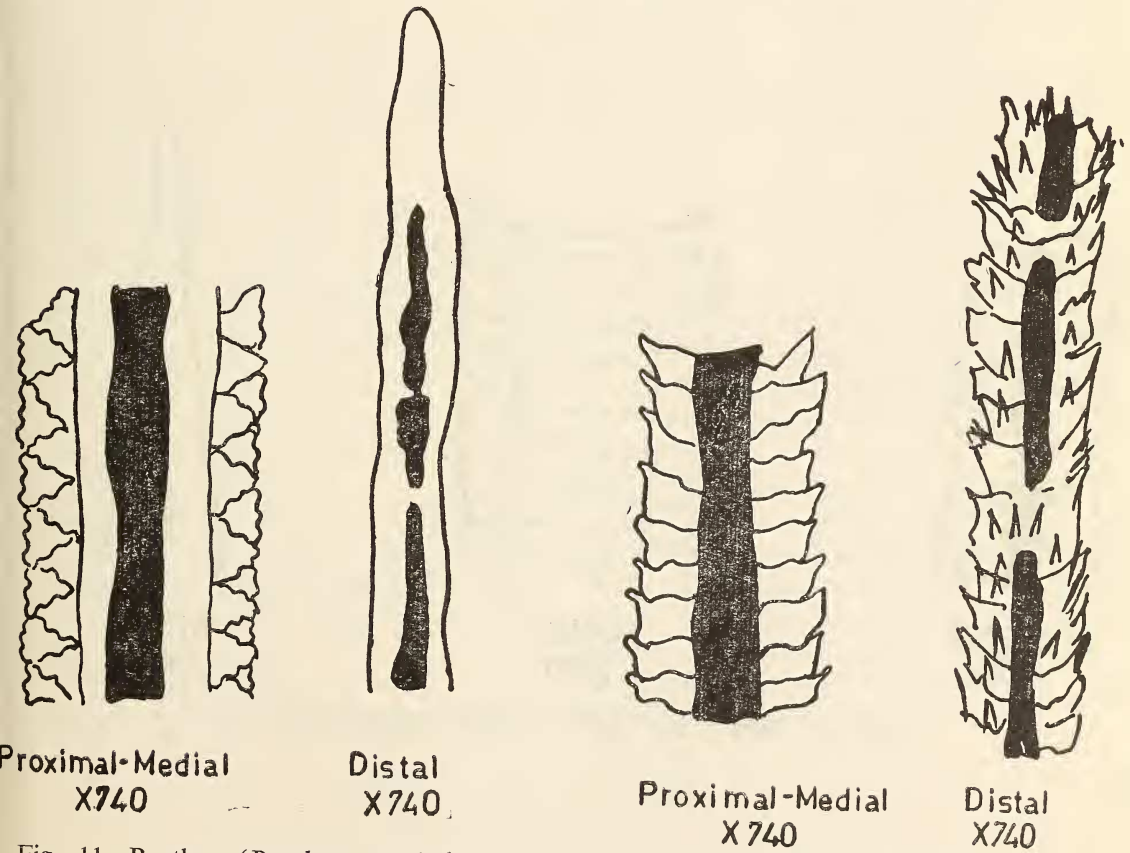
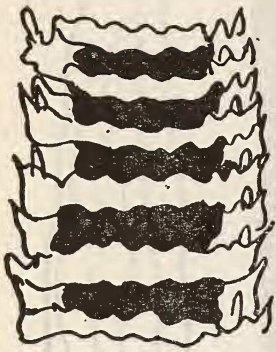
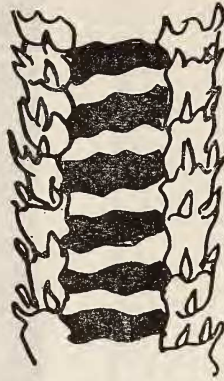


Fig. 11. Panther (*Panthera pardus*)

Fig. 16. Cattle (*Bos* sp.)



Proximal
X740



Medial
X740

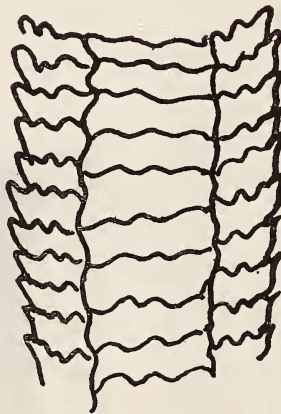


Distal
X740

Fig. 12. Jungle Cat (*Felis chaus*)



Proximal
X740



Medial
X740



Distal
X740

Fig. 13. Palm Civet (*Paradoxurus hermaphroditus*)

IDENTIFICATION OF HAIRS

RATEL *Mellivora capensis*

Fig. 14

Gross Appearance:

Length 3 to 4 cm. There are two types of hair one pure brown and the other pure white in colour. Both are slightly curved. In the proximal region hair stems are wide but gradually taper towards the distal region. The diameter at the proximal end is 51 μ .

Microscopic Appearance:

Scales coronal with dentate edges in the proximal and the medial regions of the hair. In the distal region scales appear as minute spines. Medulla is continuous in the proximal and medial regions and is not visible in the distal region.

DOMESTIC GOAT *Capra* sp.

Fig. 15

Gross Appearance:

Length 4 to 6 cm. Hair stems are curved and slightly wavy. 42 μ in diameter in the proximal region. The colour of the hair is variable.

Microscopic Appearance:

Scales are imbricate with crenate edges in the proximal region. In the medial and distal regions the borders appear plain. The medulla appears fragmented in the proximal and distal regions while it is discoidal in the medial region.

CATTLE *Bos* sp.

Fig. 16

Gross Appearance:

Length 1 to 2 cm. Hair stems are slightly curved measuring 30 μ in diameter in the proximal region. The colour of the hair is highly variable.

Microscopic Appearance:

Scales are imbricate with crenate edges in

the proximal and medial regions. In the distal region they appear flattened with minute spines. The medulla is continuous in the proximal and medial regions and fragmented in the distal region.

SAMBAR *Cervus unicolor*

Fig. 17

Gross Appearance:

Length 3 to 5 cm. Narrow in the proximal region, becoming broader in the medial and tapering off in the distal region. 180 μ in diameter in the medial region. The colour of the hair is almost pure white in the proximal region, gradually changing to yellowish gray in the medial region. The distal region is black.

Microscopic Appearance:

In the proximal region the borders appear smooth. In the medial region the scales are imbricate crenate and in the distal spiny. Medulla shows reticular polygonal appearance in the proximal and medial regions. In the distal region medulla it is not visible.

SPOTTED DEER *Axis axis*

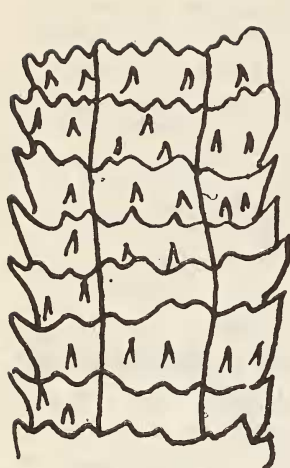
Fig. 18

Gross Appearance:

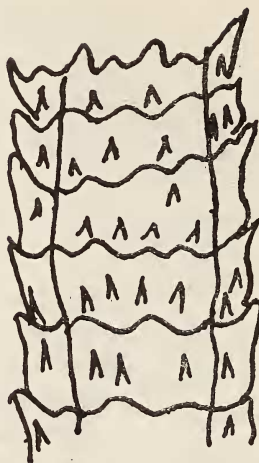
Length 3 to 4 cm. Hair stems slightly wavy. Diameter at the proximal end 84 μ . Colour, white in the proximal region changing to brown in the medial region. The distal region is yellowish brown.

Microscopic Appearance:

Dark medulla prevents cuticular structural view of the proximal region under microscope. In the medial region scales are imbricate compressed ovate type. Tip of the distal region appears spiny. Medulla appears continuous in the proximal and medial regions and is fragmented in the distal region.



Proximal
X 740

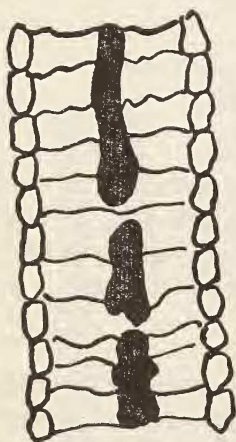


Medial
X 740

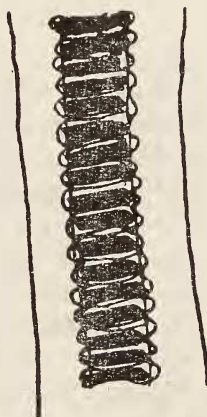


Distal
X 740

Fig. 14. Ratel (*Mellivora capensis*)



Proximal
X 740



Medial
X 740



Distal
X 740

Fig. 15. Domestic Goat (*Capra* sp.)

IDENTIFICATION OF HAIRS

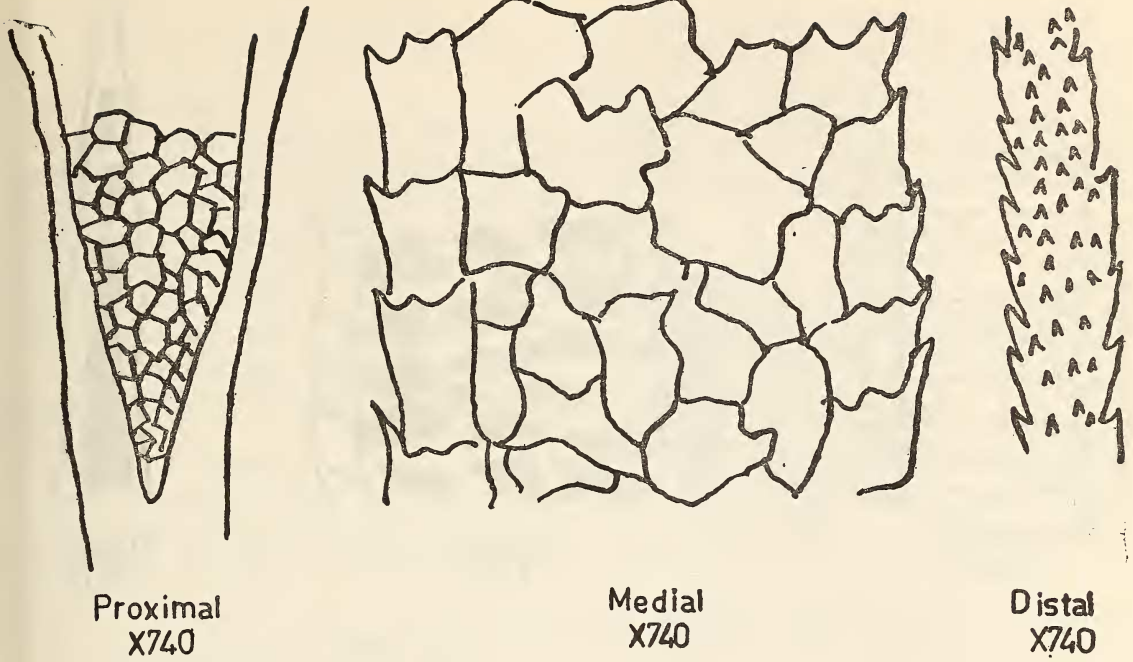


Fig. 17. Sambar (*Cervus unicolor*)

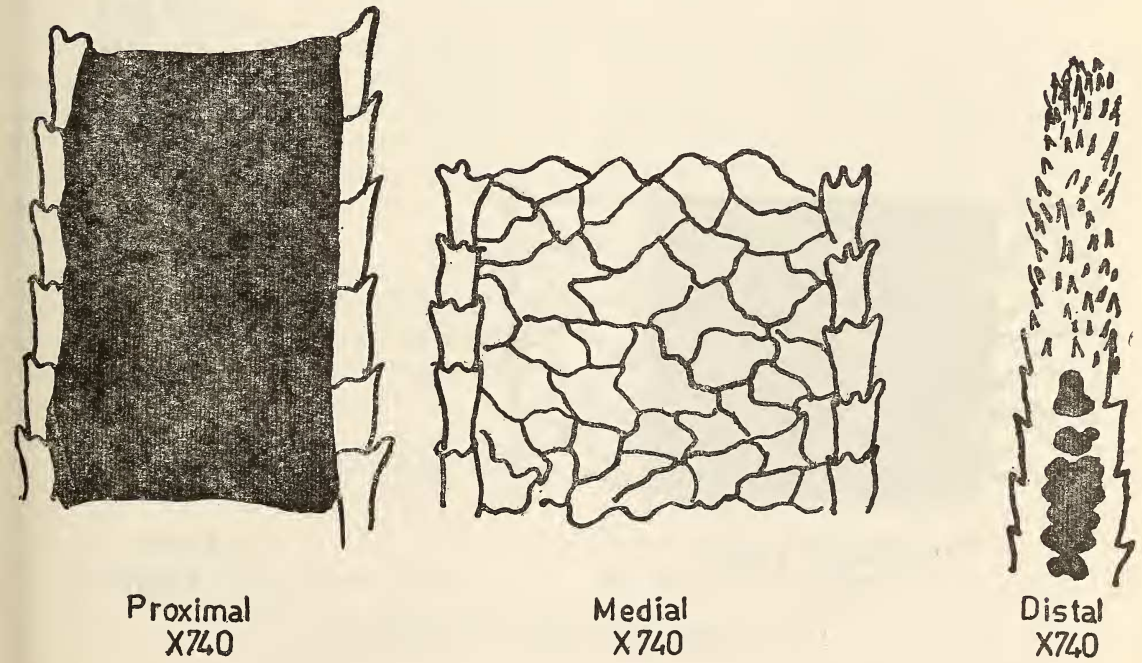
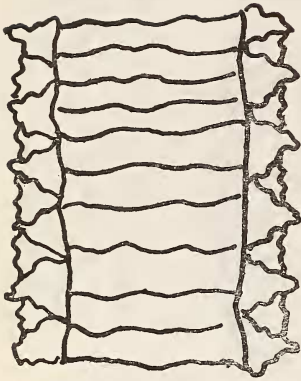
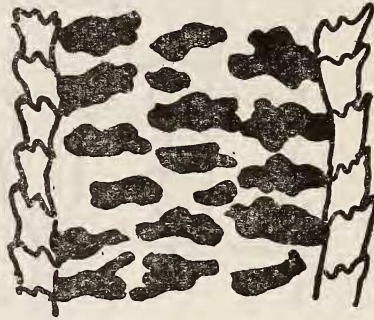


Fig. 18. Spotted Deer (*Axis axis*)



Proximal
X740

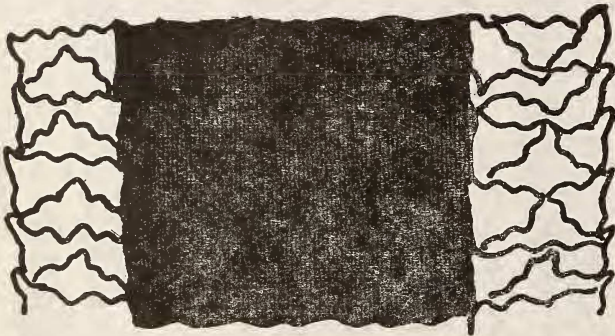


Medial
X740

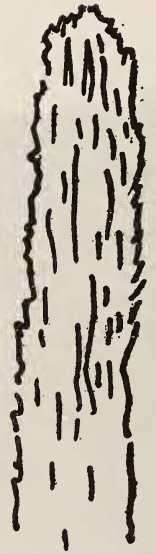


Distal
X740

Fig. 19. Blackbuck (*Antelope cervicapra*)



Proximal-Medial
X 740



Distal
X740

Fig. 20. Nilgai (*Boselaphus tragocamelus*)

IDENTIFICATION OF HAIRS

BLACKBUCK *Antelope cervicapra*
Fig. 19

Gross Appearance:

Length 1 to 2 cm. The hairs look slightly curved and are more or less equal in diameter throughout except for a gradual taper at the apex. Diameter at the proximal end 48μ . The colour of the hair is white in the proximal region with grayish coloured band immediately below the distal one third region.

The terminal portion is black. Some hairs are light brown in colour and some white and black.

Microscopic Appearance:

Scales imbricate crenate in the proximal and medial regions. In the distal region the borders appear plain. Medulla is fragmented throughout.

NILGAI *Boselaphus tragocamelus*
Fig. 20

Gross Appearance:

Length 23 to 27 cm. 140μ in diameter at the proximal region. Stems quite fragile and easily broken. Colour almost white in the proximal region. In the medial region two third portion is brown gradually changing to black in the distal region.

Microscopic Appearance:

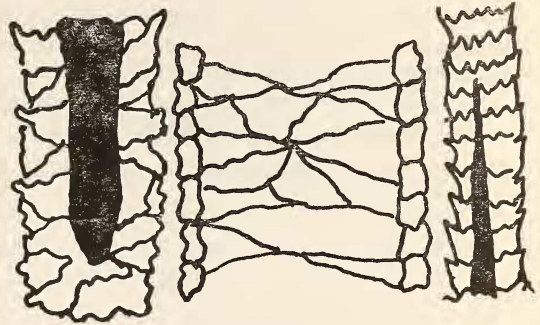
Scales imbricate with crenate edges in the proximal and medial regions. In the distal region fine long bristles are seen. Medulla continuous in the proximal-medial regions and is not visible in the distal region.

CHINKARA *Gazella gazella*
Fig. 21

Gross Appearance:

Length 18 to 22 cm. 54μ in diameter in the

proximal region increasing perceptibly in size in the medial region and then gradually tapering in the distal region. At the proximal region colour is generally black, medial region being grayish and the distal region white. Some hairs are pure white.



Proximal. X740 Medial. X740 Distal X740

Fig. 21. Chinkara (*Gazella gazella*)

Microscopic Appearance:

Scales are imbricate crenate in the proximal region, gradually becoming flattened compressed ovate type in the medial region. In the distal region the scales are coronal serrate type. Medulla is continuous all throughout.

ACKNOWLEDGEMENTS

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